DOCUMENT RESUME

ED 039 733 56 EM 008 066

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TITLE The Media Manufacturer and the Educator.
INSTITUTION Academy for Educational Development, Inc., Washington, D.C.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO BR-8-0571
PUB DATE [70]
NOTE 19p.; This is one of the support papers for "To Improve Learning; a Report to the President and the Congress of the United States by the Commission on Instructional Technology", ED 034 905

EDRS PRICE EDRS Price MF-$0.25 HC-$1.05
DESCRIPTORS *Decision Making, Educational Change, Educational Environment, *Educational Policy, *Instructional Technology

ABSTRACT

A smooth-working relationship between educators and technologists depends upon the examination of the structure of the educational process today. This paper discusses the setting in which educational decisions are made and implemented. The author identifies some of the common characteristics of educators and provides a brief explanation of the systems approach to education. The process of change and innovation is discussed. Based on this background information, he makes long and short-range suggestions for both educators and industry to consider when trying to work together. A list of references is appended. (JY)

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The Media Manufacturer and the Educator

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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by Robert G. Smith, Jr.*

THE PROBLEM

This paper has been prepared for the Commission on Instructional Technology, to discuss the following questions:

How can the educational community best specify its needs in order for industry to respond with the most appropriate equipment, programs, etc.? How can the educational community and industry establish a closer working relationship and better mutual understanding so that industry can more closely meet education's technological requirements?

These questions raise a number of answers, which deal with matters which are not easy to resolve. The origins of potential solutions must be sought in the ecology of education, the systems approach to instruction, and the process of social change.

THE ECOLOGY OF EDUCATION

Political Factors

The most common form of political control of education is the local school district, governed by a school board. The school board, in turn, is influenced by the local power structure in the major decisions made about the schools. This influence has been described by Kimbrough (1965). The major decisions are made by the influential persons in the community in informal meetings completely outside formal governmental procedures. The influential people generally develop through shared informal interaction

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a frame of reference upon which these decisions are based.

Actions of the local school boards are in turn constrained by state laws which deal with such matters as certification of teachers, attendance and curriculum. School books are often selected on the state level, or at least a limited choice selected, from which the teacher may choose.

In recent years, the federal government has made a variety of attempts to encourage innovations in the schools. However, because federal funds have been used as a kind of "bribe" to encourage school desegregation, there are strong pressures to simply pass on the federal funds to the states without any federal control at all. If this happens, the push toward innovation will be gone.

Traditionally, the classroom teacher has exercised little decision making power. The educational specialists and supervisors have been able to exert some influence in making decisions. However, the major decisions concerning the schools are still likely to be made by persons who are not educators.

The schools have been under severe attack on one ground or another for about ten years. The launching of Sputnik by the USSR in 1957 set off a major criticism of the schools for failing to develop scientists and engineers. College professors have been critical of the way their subjects have been taught in the schools, and have involved themselves in the preparation of school courses. More recently, the schools have been criticized for their failures to teach children in the inner city. Student unrest, starting in the colleges and universities, has begun to reach the high schools.

The effect of all this criticism has been to make educators and teachers

less tolerant of even modest proposals for change. School administrators have objected to the modest proposals for a national assessment of education. Teachers are becoming unionized, and turning to the strike as a means of securing their demands.

The implications for those who wish to develop and sell equipment to the schools are clear. There are many groups which may have influence on the decision to buy. They must all be reached.

The Educator and His General Characteristics

As Biddle and Rossi (1967) have pointed out, education is labor-intensive--that is, relatively little equipment is involved in the educational process. The capital investment in the public schools in the main consists of the real estate on which the school stands, the buildings, and the furniture.

The industrial revolution, then, has not yet come to education. The teaching process most commonly means the students and one (or sometimes more, in the case of team teaching) teacher in a room. At the primary level, especially, there is little differentiation of functions. The teachers are viewed as nearly interchangeable units, so that a given teacher may be assigned to teach in a different grade each year.

In an insightful article on why so little change occurs in education as a result of educational research, Travers (1962) has described some general characteristics of educators. Sieber (1968) describes related matters.

The first point to be noted is that educators represent a highly selected subculture. A rigorous self-screening takes place because of the requirements of teacher certification and the courses needed to obtain a certificate. The selection process is still more stringent for the principals and super-

intendents. They generally must have both a teaching certificate and experience as a classroom teacher.

Travers points out that while educators tend to be above average in intelligence, they tend not to include many of those who are very high in intelligence. They are generally not very innovative or scientific; rather they prefer the day-to-day routine of teaching or administration, and are conservative in outlook.

The human aspects of the relationship between students and teachers tend to be highly valued by educators; as a result they tend to resist the idea of replacing any human function with equipment or other media. One form this resistance takes is a tendency to label innovations as just another "aid" to the teacher--even if the innovation could (and perhaps should, for maximum advantage) radically change teacher functions.

Even those who are convinced of the need for radical reform in our schools, make statements about "nothing ever replacing the teacher." In addition, every time any piece of equipment comes into the schools, or is even suggested, the question of "what about human warmth?" is raised. This suggests an ideal which forgets that there are also such qualities as human indifference, anger, sarcasm, and laziness.

While the teacher or principal may have little direct decision-making power over the major matters, they can certainly affect equipment usage, and thereby purchases. The legendary "closets full of unused audiovisual equipment" which are supposed to exist in the schools, certainly do not promote the sales of new equipment.

Further, one can hardly blame the teacher for neglecting to use equipment which he has not been taught to use with ease; which is awkward and

clumsy to move around; which is difficult to check out of the supply room; and for which there are no new and up-to-date tapes, films, or slides.

THE ROLE OF MEDIA IN A SYSTEMS APPROACH TO EDUCATION

The Concept of an Instructional System

The present author (Smith, 1966) has described the concept of an instructional system as an integrated set of media, methods, people, and equipment, performing efficiently the functions required to accomplish one or more objectives.

This concept implies that:

1. There are clearly defined goals for the system. For instruction, these goals are objectives which describe the behavior we wish to produce in the student.

2. There are functions that are to be carried out by the media, methods, people, and equipment. The particular way these functions are to be carried out, and by which means, is a matter to be decided on a cost-effectiveness basis. Thus the system concept is neutral as to whether a particular function requires people or equipment. It only asks that the least expensive way that accomplishes the objective be selected.

3. The various elements that make up the system are properly integrated to carry out the objectives of the system.

An Example of a Non-System

In order to try to illustrate the nature of an educational system, let me describe a non-system. This is the true story of how my daughter learned to hate French through educational television.

The City of Hampton, Virginia was proud of the fact that they used educational television. Stories on the use of television in the schools regularly appeared in the newspapers extolling the features of television for education. Three times a week, for a half-hour period, a course in French was broadcast. For three years, during the fourth, fifth and sixth grades, under three different teachers, here is what happened to my daughter. Three times a week, the teacher quieted the pupils, and turned on the television set. The broadcast was all in French. When the program was over, the teacher turned off the set and moved on to other subjects.

The children thus learned that French was a dull subject that no one could understand. When I talked to the teachers, they admitted that they didn't like the situation, but none of them knew any French and they could not support the broadcasts with explanations or practice exercises. But they did know if the principal came by and looked in their door window, they had better have the television set on.

When I talked to the principal, he told me that he knew of the problem, and had complained to the administration. He felt that special training should have been provided the teachers, or at least a traveling French teacher to help his teachers. But he did know that if the language supervisor happened to come by, those television sets had better be turned on.

When this situation is analyzed from the system standpoint, the objectives were not clearly established, all the functions needed to accomplish them were not effective, and there was no coordination among the components which should have been carrying out the functions.

System Objectives

Objectives are the purposes of an instructional system. They are an explicit statement of the performances expected of the student at the end of his instruction. As described by Mager (1962), in order to be sufficientl specific the objective should specify (a) a statement of the performance, expressed in action words; (b) a statement of the conditions under which the performance will be observed or measured; and (c) a standard of accuracy and/or time.

Ammerman and Melching (1965) point out that objectives are organized into a hierarchical structure:

1. General objectives describe an entire course or a major part of a course.

2. Terminal objectives represent meaningful units of job or life behavior subsumed in the general objective.

3. Enabling objectives represent knowledges or skills that must be mastered if the student is to attain the terminal objectives.

The present author (Smith, 1964) has described the processes involved in deriving training objectives for specific jobs. The basis for training objectives is a detailed description of the job. The problem of deriving educational objectives is more difficult, and the basic questions are much broader. Which parts of education are similar to job training? Should we base educational objectives on preparation of the individual to fit into society, or should we try to develop each individual to his greatest potentia To what extent should the individual student develop his own objectives? Are each of these rationales appropriate to different aspects of education?

These broad and fundamental questions are as yet unresolved. In order to proceed with the design of an instructional system, it is possible, although not desirable, to by-pass them. What is essential for system design is that objectives be specified in terms of Mager's criteria--that is, performance, conditions, and standards--and then organized in accordance with the suggestions of Ammerman and Melching on defining general, terminal, and enabling objectives.

Objectives specified in these terms provide a guide to the selection of media, methods and other equipment, and to how the instructional staff and students should perform.

Instructional System Functions

Smith (1966) has identified several functions which must be performed in an instructional system.

The Practice of Performance. This function is concerned with the practice of a terminal objective or an enabling objective which requires performance. The most important requirements are simulation of the cues and responses involved in the objective, coupled with a way of providing the student with knowledge of the results of his practice.

The Practice of Knowledge. This function deals with the practice of enabling objectives representing knowledge. The means for practicing knowledge include workbooks, programmed texts, and classroom communicators, such as the EDEX system. As with the practice of performance, knowledge of results should be provided.

The Presentation of Knowledge. Here the concern is with one-way presentation of knowledge or information to the student. Research results

suggest that the message is more important than the medium, although the characteristics of the medium may limit the kinds of messages which may be sent.

The Management of Students. In this function are included all the things that are necessary to keep the student profitably occupied in the functions described above. Included here are ways of dealing with individual differences between students, and ways of motivating students to learn.

Quality Control. The function of quality control requires four general processes (Smith, 1965). The first is the development of tests to measure the attainment of objectives. The tests are then administered to the students. The results are fed back to the system managers. Finally, action is taken to improve those parts of the system which are not accomplishing the objectives.

The Role of Technology in an Instructional System

In an instructional system, the various functions are carried out by a variety of components. The system concept is neutral on the point as to whether these components should be human or not. The decision on the means for executing system functions is made on a basis of relative cost and effectiveness.

A particular element of the educational technology, such as a tape recorder, will perform one or more of the functions required to accomplish an objective. Whether a specific element is suitable will depend both on the objective and the function being carried out.

If a school has adopted the system concept, it will be relatively easy to specify the requirements for equipment and programs. They will perform the required functions to accomplish specific objectives.

EDUCATIONAL INNOVATION

It was noted earlier that education is a labor-intensive enterprise. The introduction of any item of equipment into such a situation represents a fairly major innovation. Thus it is important to consider the problems of innovation in education.

A review of the recent literature on innovations and their spread, made by McClelland (1968) in a study of the process of effecting change, has shown that the principal emphasis in the literature falls on the difficulties of innovating.

The diffusion of innovations has been described by Rogers (1968) as being affected by four key elements: the innovation, communicated to members of a social system, who adopt it over a time period.

Considering the characteristics of an innovation, Rogers describes the following as being the features that appear to affect the rate of adoption:

1. Relative advantage--the extent to which an innovation is visibly better than what it supersedes.

2. Campatibility--the extent to which an innovation is consistent with the present values and previous experience of the potential adopter.

3. Divisibility--the extent to which an innovation may be tried out on a limited or partial basis. Divisibility favors adoption.

4. Complexity--the characteristic of an innovation which involves difficulty on the part of people to understand or use it. More complex

innovations either will spread slowly or must be integrated with a carefully planned program of training.

5. Communicability--the extent to which the results of the adoption or rejection of the new idea or item are visible to others. This characteristic explains why material things diffuse more rapidly than concepts.

The Human Resources Research Organization and its staff have had extensive experience in assisting the Army to use training innovations based on research. We have learned a number of lessons about factors that increase the likelihood of successful implementation of research results:

1. Only rarely do research innovations become adopted on the basis of a formal written report. Instead, the results of the research (provided that the innovation is superior to existing practice) must be clearly communicated to every decision-making level.

2. Adoption is aided by the involvement of military personnel in the research and their later endorsement of the value of the innovation.

3. It is worthwhile to do a great deal of work to engineer the innovation so that it can fit relatively easily into the existing training structure.

4. For some innovations, it has been necessary to conduct training programs and prepare guidance documents for Army personnel who are to use the new technique.

A point which should not be overlooked is that the Army generally is interested in using the results of training research and development as a means of obtaining not only improved training, but a return on its investment in research.

We will return to these points when specific suggestions are made for improving the likelihood of innovation in education.

INSTITUTIONALIZED INNOVATION

The American way of organizing education involves thousands of relatively independent school districts. Many districts are not sufficiently large to have a long-range planning staff whose function it is to systematically seek for innovations and to make sure that they are institutionalized in an orderly way. However, it is not inconceivable that the larger districts, or confederations of smaller districts, could develop such staffs.

The only insititutions, to my knowledge, which have developed such a planning staff are the Armed Forces. The general characteristics of this process will be described below.

Projection of the Future

In the Armed Forces, planning is developed which covers a series of time periods, ranging up to about twenty years into the future. For each of these time periods there is a projection of the characteristics of the future which are of importance to national defense. The most important point for the topic of this paper is that each of these plans is periodically revised to bring new developments into their proper perspective, and the new plan for the farthest year is developed. Thus there is a series of plans and projections of the future, each regularly modified and refined.

Plans for New Weapons and Organizations

Along with projections of future conditions, there are projections of

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new organizations and new weapons that will be required to deal with the problems of the future. This process of outlining new organizations and weapons in turn becomes more detailed and specific as time goes on.

Another part of the planning process is the development of technological forecasts which not only predict the state of technology of the future, but also represent goals toward which the scientists and engineers can work to make the predictions come true.

Bringing the Innovations into Being

As technological developments make new weapons and organizations feasible, plans are developed for bringing the innovations into being and phasing out the obsolete.

New weapons are designed as complete systems. Not only are the hardware components integrated, but also requirements for real estate, power, and other aspects of the system--especially for personnel. The equipment is designed for human use, although there may be trade-offs in which the human engineer loses out to the hardware engineer. The new jobs required are identified, as are the numbers of men who will be needed in each type of job. Training plans are developed to bring the people and the hardware together at the same time.

As equipment becomes available from the manufacturers, it undergoes various tests, including tests of the complete system including personnel, before it is finally adopted.

Another aspect of the process is the development of doctrine--the policy and procedures for the use of the new equipment and organizations. It provides the system commanders and managers with guidelines on how to use the new equipment effectively.

As with any complex human endeavor, there are problems aplenty in bringing a complex combination of men and machines to completion. Coordination and decision problems abound, because many different agencies are involved, as well as different kinds of specialists. It is no accident that many of the new management techniques, such as PERT, cost-effectiveness, and program budgeting, have been developed by the armed forces in order to deal with these problems. The concept of the system itself received new impetus from the work of the military in developing new weapon systems.

Despite the problems, the services are far ahead of other groups in having mechanisms for the orderly introduction of innovations.

A Planning System for Education

It seems appropriate for education to begin to develop a planning system which could bring innovations into use on a planned, regular basis, and thus provide a means of self-renewal. This system should encompass the following features:

a. Forecasts for varying time periods of the major trends in our society which have implications for education.

b. Technological forecasts in all the fields which may have implications for education, as well as regular monitoring of actual developments. These fields might include:

(1) Behavioral Science

(2) Communication

(3) Operations Research

(4) Architecture and City Planning

(5) Information Science

(6) Data Processing

c. Explicit formulation of requirements for new systems and supporting organizations.

d. Introduction of these systems and maintenance, until it is time to introduce a new one.

At stage c above, requirements for industry will be developed.

SUGGESTIONS FOR SOLVING THE PROBLEM

In the preceding material, background has been developed for posing some suggested answers to the problem of how to create better cooperation between the educator and industry. We have seen that educators are homogeneous members of a labor-intensive enterprise, so that nearly any introduction of hardware means a significant innovation. The systems approach has been reviewed, and the process of change has been discussed.

Now we are in a position to make a number of suggestions, both for the short-range and for the long-range, for both educators and industry.

Short-Range Suggestions

For Educators

1. Work toward specifying the objectives of instruction in terms of specific performances to be developed in students. With such objectives it will be possible for both educators and industry to see how specific media and programs can be of assistance in meeting the objectives.

2. Provide industry with feedback on how various pieces of hardware and software work--or don't work. If an item is too cumbersome to use, and winds up in the storeroom, say so.

3. Maintain surveillance of new developments and be willing to make and support appropriate innovations.

For Industry

1. Keep in mind that the education establishment, representing a labor-intensive enterprise, doesn't really feel it needs you. Its members will probably view you with suspicion, as being concerned more with profits than with service. Further, you represent change, and change can be uncomfortable. Therefore, it is up to industry to take the initiative with regard to contacts with educators. Join educational organizations, attend meetings, and learn the characteristics of the educator.

2. Develop the kinds of innovations that have a high likelihood of spreading. These should be:

a. Of high relative advantage. Learn enough about education so that you can learn what the problems are as viewed by educators. Then develop items that will have a clear relative advantage in solving those problems.

b. Divisible. For the short-run it is desirable to develop items that can be put to use on a trial basis in part of a school. In this way, others can hear about the new item.

c. Yielding highly visible results. The effects of the item in solving an educational problem should be highly visible. Thus industry will have to do much more in the way of sponsoring evaluative trials of the item so that clear data on its capabilities can be developed.

d. Simple to use. The item should be "human-engineered" to make it easy to use. Instructions should be tested for clarity. If training is required, training plans and programs should be developed. Provide suggestions for the optimal use of the item.

3. Identify the innovators. Despite the general conservatism and resistance to change of educators, there are persons who are willing to innovate. These persons should be identified, for they may be willing to give your products a first trial, from which others may learn and decide to adopt. Some organizations within the galaxy of educational societies are likely to contain more than their share of potential innovators. These are the associations concerned with audiovisual devices, data processing, broadcasting and programmed instruction.

4. Learn how important educational decisions are made. In most communities the power to make the most important decisions does not lie with the educators. The amount of funds, the degree of innovation, or the curriculum may be guided more by persons in political or economic power than by educators. These people should be studied and influenced toward innovation and change.

Long-Range Suggestions

For Educators

1. Work toward the admission into your ranks of people with a diversity of backgrounds, so as to encourage new and different views of the educational process. Work toward the changes in teacher and supervisory certification legislation which will make this possible.

2. Work for a system of long-range educational planning that will permit orderly trial and introduction of innovations.

3. Work toward acceptance of the system concept, with clear definition of objectives and specific functions to carry out those objectives.

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For Industry

1. Work toward reducing the forces making for homogeniety among educators. Lobby to change certification requirements.

2. Work toward the acceptance of the view that equipment can perform many educational functions as well as, or better than human beings. Your problem is to make education less labor-intensive. Your techniques may include lobbying, advertising, and other forms of persuasion. The concept of the systems approach to education contains the important ideas toward which you should be working.

3. Work toward a system of long-range planning that will lead to planned innovation. Each of these innovations should open sizable markets to you.

4. Educate those in power to change their views toward the amount and scope of educational innovation and the need for equipment and programs.

5. Sponsor demonstration systems. In order to show what could be done by really innovative approches, industry associations could build complete instructional systems. With the potential of present day technology which is not being used, such systems could be strong stimuli toward change, if given adequate publicity.

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